

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

UTILITY PATENT APPLICATION FOR:

DISPLAY CONFIGURATION

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DISPLAY CONFIGURATION

TECHNICAL FIELD

This invention relates generally to displaying information. More particularly, the
5 invention relates to determining a display configuration for displaying information.

BACKGROUND

Computer systems are increasingly being designed in the context of a world where
computing is ubiquitous. Computer systems are becoming smaller, cheaper, and more
10 powerful. In an effort to reduce costs and reduce size of computer systems, displays
provided with these computer systems may not completely satisfy a user. For example,
the displays may be too small to efficiently perform word processing on a document or
read a stored document.

15 SUMMARY OF THE EMBODIMENTS

According to an embodiment, a display configuration associated with displaying
information from at least one source is determined using a cost metric.

According to another embodiment, a plurality of display configurations are
determined using at least a cost metric and each configuration is evaluated based at least on
20 the cost metric. A display configuration is selected based on the evaluation.

BRIEF DESCRIPTION OF THE DRAWINGS

Various features of the embodiments can be more fully appreciated, as the same
become better understood with reference to the following detailed description of the
25 embodiments when considered in connection with the accompanying figures, in which:
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Figure 1 illustrates a block diagram of a system, according to an embodiment;

Figure 2 illustrates a block diagram of a display real estate control system,

according to an embodiment;

5 Figures 3A-B illustrate examples of display configurations for a multi-user system;

Figures 4A-B illustrate examples of display configurations for a single user

system;

Figure 5 illustrates a flow chart of a method for selecting a display configuration,

according to an embodiment; and

10 Figure 6 illustrates a hardware block diagram of a computer system, according to

an embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

For simplicity and illustrative purposes, the principles of the embodiments are described. Moreover, in the following detailed description, references are made to the 15 accompanying figures, which illustrate specific embodiments. Electrical, mechanical, logical and structural changes may be made to the embodiments without departing from the spirit and scope of the embodiments.

According to an embodiment, a system is provided that is operable to receive information from one or more sources and display the information in a variety of 20 configurations. A particular configuration may be selected based on one or more metrics. Examples of the metrics include cost metrics, display lifetime metrics, power consumption metrics, and usage metrics. In one embodiment, the system includes a display that may be used by a plurality of computer systems for a fee. A cost metric

associated with a cost of using the display and/or a cost of operating the display is determined. Based on the cost metric and possibly other metrics, a particular display configuration is selected for displaying the information from one or more of the computer systems.

5 Figure 1 illustrates an embodiment of a system 100 including a display real estate control system (DREC) 10. The DREC 10 may include a display computer system 12 and a display 14. The display 14 may be incorporated with the display computer system 12 as a single device or attached to the display computer system 12 as a separate unit. The computer systems 20 transmit information to the DREC 10 for display on the display 14 in 10 the DREC 10. The display computer system 12 controls the display configuration, which is the visual representation of the information received from the computer systems 20 that is displayed on the display 14. The display computer system 12 may evaluate one or more factors, such as power consumption metrics, lifetime metrics, cost metrics, user display settings, etc., when determining the display configuration. In one embodiment, the DREC 15 10 operates as a community display system and is operable to display information from a plurality of the computer systems 20 simultaneously. The factors are evaluated to determine, for example, the size of a portion of the display 20 allocated to each of the computer systems 20 having information displayed on the display 20 and cost of displaying information using the DREC 10. In another embodiment, the DREC 10 displays information from a single one of the computer systems 20 at any particular time, 20 and evaluates the factors to determine, for example, the size and cost of using the DREC 10 to display information. The DREC 10 may include modes, such that the DREC 10 can

function as both a display operable to display information from multiple computer systems simultaneously or display information from one computer system. Also, the DREC 10, when operable to display information from multiple computer systems simultaneously, may only display information from one computer system as determined by the display 5 computer system 12. For example, if information is only available from the computer system 20a, then that information is displayed on the display 14.

The display 14 is broadly defined to include any combination of software and hardware associated with the visual representation of data. For example, the display 14 may include a display panel, display controller, and drivers. Various types of display 10 technologies may be used, such as cathode ray tube, liquid crystal display, digital light projection, plasma, organic light emitting diodes (OLEDs), etc. In one example, the display hardware supports control of portions of the display. For example, the hardware may include OLEDs, tiled displays, or multiple displays. OLEDs allow pixels or sub-pixels to be individually controlled, while tiled displays allow control over groups of 15 pixels. The display computer system 12 may control portions of the display 14 to change a display configuration. With OLEDs, this may include individual control of sub-pixels, pixels or a group of pixels, such as controlling, intensity, color, refresh rate, etc. Also, the display computer system 12 may shift images on the display 14 to generate different display configurations.

20 The computer systems 20 may include substantially any type of device that is operable to transmit information to the DREC 10. Examples of the computer systems 20 may include laptops, personal computers, servers, personal digital assistants (PDAs),

cellular phones, small computer systems such as pen computers, keychain computers, or watch computers, etc. The computer systems 20 may be connected to the DREC 10 directly or through the network 40. The network 40 may include a local area network (LAN) and/or a wide area network (WAN). The network 40 may include wired and/or 5 wireless networks. For example, using a wireless LAN 40, the computer system 20b, which may include a PDA, laptop or other mobile device with a wireless network connection, connects to the network 40 to transmit information to the DREC 10 to be displayed on the display 14. Also, servers connected through the Internet may be connected to the DREC 10. For example, the computer system 20d includes a server and 10 transmits information, such as advertisements, to the DREC 10 to be displayed on the display 14. In another example, the DREC 10 is provided in an airport, and the computer system 20c comprises a server located at the airport connected to the DREC 10 via a LAN and/or a WAN. The computer system 20c may display flight information, a map of the airport, streaming video describing security check-in procedure, etc. It will be apparent to 15 one of ordinary skill that the DREC 10 may display substantially any type of information and can be located in variety of environments and settings.

The computer systems 20 may be connected to the DREC 10 without using the network 40. For example, the computer system 20a may be connected to the DREC 10 through a port, such as a USB or serial port, and may use a wired or a wireless connection, 20 such as an infra-red or radio frequency connection. In addition, the DREC 10 may receive information from a memory device 30, such as a floppy disk, CD-ROM, memory card, etc.

Figure 2 illustrates an embodiment of the DREC 10. The DREC 10 includes a power model 110, a power meter 112, a usage model 114, a usage meter 116, lifetime model 122, cost model 124, source display settings 118, and a control engine 120. The DREC 10 may be implemented in hardware, software or a combination thereof as would 5 readily be implemented by one of ordinary skill in the art. For example, the control engine 120 and/or other components of the DREC 10 may be implemented in software at the operating system level or windowing environment level that controls the configuration of the display 14. Alternate embodiments implement the DREC 10 in hardware or at the firmware or application layers.

10 The control engine 120 considers one or more factors, such as power consumption metrics, lifetime metrics, cost metrics, user display settings, etc., when determining a display configuration. These factors are determined using the components of the DREC 10. The power model 110 can be used to determine a power consumption metric related to the power consumption of the display 14. Power consumption as used herein can 15 include specific power metrics such as average power or peak power or broader power metrics such as power multiplied by execution time (e.g., energy). Examples of the power consumption metric may include an estimate of the power consumption of the display 14, such as in terms of average power, peak power, and energy, and/or an estimate of the future power consumption of the display 14. A prediction of future power consumption 20 may be based on the current use of the display 14 and/or a determination of the typical use of the display 14. Other power consumption metrics may be associated with power savings associated with displaying information on the display 14 using different

configurations. For example, a power consumption metric is determined based on a first display configuration, and the power consumption metric is determined for a second display configuration, such as displaying the information using different colors, moving images on the display 14, dimming some or all of the display 14, etc. Other examples of 5 power consumption metrics may include power consumption of the display computer system 12, and estimated future power consumption of the display computer system 12.

The power model 110 may be generated by profiling power consumption of the display 14 and/or one or more similar displays. Profiling may include a historical analysis 10 of power consumption data for the display 14 and/or one or more similar displays. Power consumption data, which may include measured power consumption, can be captured over a period of time for the display 14 or for one or more similar displays. The power consumption data, for example, can be obtained during a study of the power consumption and use of one or more displays, which may be similar to or include the display 14. Also, 15 the power meter 112 may measure power consumption for the display 14, which may be included in the power consumption data. The power consumption data can be used to generate the power model 110 and as input to the power model 110 to determine a power consumption metric. The power model 110 may include a statistical analysis or other calculations performed on the power consumption data for the display 14 to determine the power consumption metric, such as estimated power consumption or estimated future 20 power consumption for the display 14.

The power meter 112 determines the power consumption of the display 14 and the display computer system 12. For example, the power meter 112 may measure current and

voltage to determine power consumption of the display 14 and the display computer system 12. The power metering can be performed at the overall computer system level or at the individual subcomponent level. The output of the power meter 112 may be provided to the power model 110 and the control engine 120. The power model 110 may 5 use the determined power consumption as power consumption data for determining a power consumption metric. The control engine 120 may use the determined power consumption to estimate operation costs for the display 14.

The usage model 114 can be used to determine a usage metric for the display 14. A usage metric is a metric associated with displaying information on the display 14, such 10 as the amount of use of the display 14, estimated area of focus for the display 14, user preferences for viewing displayed information, estimated future use, etc. By profiling the use of the display 14 or one or more similar displays, the usage model 114 captures the typical usage behaviors of the display 14, and the usage behaviors are evaluated to identify usage patterns of the display 14. From the usage patterns, the content and intent of the use 15 of the display 14 may be determined. The usage model 114 may include a historical analysis of the use of the display 14 and/or one or more similar displays. The usage model 114 can be used to categorize the inefficiencies of the historical use of the display 14 and to determine different configurations for displaying information. The historical analysis can examine the use of a display by a particular user, by a class of users, and/or by general 20 use not categorized by class. The historical analysis may include an analysis of the display captured offline, such as during a study of the use of the display, and/or online, such as the use of the display 14 by a particular user or computer system of the computer systems 20.

U.S. Patent Application Serial Number 10/033,738, entitled “Software-Directed Energy-Aware Control Of Display” by Ranganathan et al., which is incorporated by reference in its entirety, discloses conducting an analysis of the usage of a display to determine an area of focus.

5 The usage model 114 may include a statistical analysis and other calculations performed on usage data including the usage patterns to determine a usage metric. For example, usage patterns of the display 14 or one or more similar displays may be analyzed for a plurality of users. The output of the usage model 114 may include a table summarizing usage patterns, such as the average sizes of windows utilized by a user of the
10 display, a histogram of colors used by a typical user, and a typical area of focus on the display. Based on the output of the usage model 114, the control engine 120 may increase the cost of displaying an image in the area of focus, charge less for images displayed outside the area of focus, and/or change colors or dim an image to reduce power consumption and operational costs of the display 14 and increase the remaining life of the
15 display 14.

 The usage meter 116 captures the current usage of the display 14 by individual users during periods of time and predicts how the usage pattern is likely to change. For example, the usage meter 116 stores the length of time and position of a window or image being displayed. The output of the usage meter 116 may be provided to the usage model
20 114 and the control engine 120. For example, the usage model 114 may utilize the data captured by the usage meter 116 to determine usage patterns. Also, the control engine 120 may utilize the output of the usage meter 116 to determine the cost of using the display 14

and operational costs. Data captured by the usage meter 116 may also be used by the lifetime model 122 to determine a lifetime metric.

The lifetime model 122 can be used to determine a lifetime metric for the display

14. The lifetime metric may include a metric associated with the lifetime of the display
- 5 14. Examples of the lifetime metric may include an estimate of past use and a prediction of future use of the display 14. A prediction of future use may be based on the current use of the display 14 and/or a determination of the typical use of the display 14. The lifetime metric may also be associated with the past use and predicted remaining life for groups of pixels, one or more pixels or sub-pixels (e.g., each red, green, and blue component of each
- 10 pixel).

Past use of the display 14 may be determined by measurement or may be estimated. The usage meter 116 may be used to measure use parameters of the display 14, such as intensity of each sub-pixel, length of use, etc. In one example, current or light output is measured to determine past use of each sub-pixel. Also, an approximation may

- 15 be used to estimate past use of a group of pixels based on measured parameters for a subset of pixels or sub-pixels. The measured usage data is input into a mathematical model to determine the past use and estimate the remaining life of pixels or sub-pixels.
- Also, an estimate of past use may be based on typical use of the display 14 and the length of operation of the display 14. Measured or estimated usage data may be input into the
- 20 mathematical model to determine a lifetime metric, such as an estimate of past use and a prediction of remaining life for pixels in the display 14. The mathematical model may be determined using parameters experimentally derived from testing the lifetime of similar

displays. For example, the mathematical model may be determined based on a historical analysis of lifetime data, such as decrease in pixel or sub-pixel intensity over time, etc. Also, display degradation curves provided by manufacturers may be used to estimate remaining life of a pixel or an entire display. For example, the mathematical model may 5 include degradation curves for sub-pixels. Based on the measured or estimated past use (e.g., number of hours of use), the remaining life of a sub-pixel is determined using the degradation curve.

In one embodiment, estimates of past use, measured values associated with past use, estimates of remaining life for pixels may be stored in hardware or software registers 10 for each pixel of the display. Periodically, or as required by the lifetime model 122, these values may be updated. In another embodiment, an approximation of pixel use is determined for regions of the display 14 larger than a single pixel, such as a group of pixels. Thus, fewer computations for determining past use and remaining life of pixels are needed, and less memory is needed to store lifetime metrics.

15 Another component of the display computer system 12 is the source display settings 118. These are display settings for the display 14 that are required for displaying information from a particular source, such as for each of the computer systems 20. Examples of the source display settings 118 may include displaying an image on the display 14 in one or more specified colors, size of the image, and location of the image. 20 For example, the computer system 20a shown in figure 1 transmits information, such as a company logo, and source display settings 118 to the DREC 10. The source display settings 118 specify that the logo must be displayed in blue and gold. Thus, the control

engine 120 may not modify the colors of the logo, even if modifying the colors results in reduced power consumption and increased remaining life for the display 14.

Another component of the display computer system 12 is the cost model 124. The cost model 124 determines a cost metric associated with using and/or operating the

5 display 14. A cost metric associated with using the display 14 may include a monetary cost based on the size of an image to be displayed and the length of time the image is to be displayed. For example, screen area of the display 14 can be rented at 50 cents per 1024 pixels per hour. Screen area is the area used to display information on the display 14. Other factors may also be used to determine the monetary cost of using the display 14.

10 For example, cost may be computed as the output of a function that factors the size of the image, the length of time the display 14 is used to display an image, the power consumption of displaying an image, the impact on lifetime of the display 14, and may also adapt for different times of the day. For example, with OLED displays, the power consumption of the display is dependent on the colors of the image being displayed.

15 Green sub-pixels generally consume lower power than red sub-pixels, and thus an image using more green sub-pixels may require less power to be displayed and a user may be charged less. Similarly, the lifetime of one display color, e.g., red sub-pixels, may be shorter than that of another display color, e.g., green sub-pixels, and thus images that require more red sub-pixels have a more detrimental affect on display lifetime and can

20 cost more to be displayed. Similarly, the cost associated with the using the display 14 during peak traffic times may be different from the cost associated with using the display 14 during less busy times. Instead of a pre-determined cost function, the cost metric can

be approximated from extrapolations of data from monitoring the billing associated with various display usages at various times.

The cost model 124 may also be used to determine an operating cost for the display 14 and the cost of using the display 14 may be determined from the operating cost.

- 5 For example, similarly to the cost of using the display 14, an operating cost may be determined as the output of a function that factors one or more of the size of the image, the length of time the display 14 is used to display an image, the power consumption of displaying an image, the impact on lifetime of the display 14, and may also adapt for different times of the day. Then, the cost of using the display 14 may be determined as a
- 10 function of the operating cost, such as a predetermined percentage increase.

In one example, the cost model 124 may include a historical analysis of factors such as size of a displayed image, the length of time of displaying an image, the power consumption of displaying an image, the impact on lifetime of the display 14, display times, etc., and an analysis of how these factors relate to monetary costs for a display.

- 15 Based on the historical analysis, each of these factors may be estimated for an image from a source to be displayed on the display 14. Based on these estimations, a cost metric, such as cost of using the display 14 or operating cost of displaying the image, is determined.

- 20 The control engine 120 determines one or more display configurations for displaying information received from one or more sources, such as one or more of the computer systems 20. A source may also include a user inputting information into the DREC 10 using an I/O device (not shown), such as a keyboard, mouse, etc. For example, the control engine 120 receives information to be displayed on the display 14 from a

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source, such as the computer system 20a shown in figure 1. Along with the information, the computer system 20a may send source display settings 118 for displaying the information. The source display settings 118 may include one or more of the size of the image including the information to be displayed, the length of time the image is to be displayed, the time of day for displaying the image, the position on the display 14 for displaying the image, whether the image may be modified such as by changing color or dimming the image, etc. Some of the display settings 118 may be determined by the control engine 120. For example, if the information from the computer system 20a includes a bitmap, then the size may be determined by the control engine 120. However, the size of the image may be changed if the source display settings 118 specify that the size of the bitmap may be reduced or increased. Also, these are examples of the source display settings 118. The source display settings may include one or more of these settings and may include different settings.

The control engine 120 utilizes at least one of the power model 110, the lifetime model 122, the usage model 114, the cost model 124, and the source display settings 118 to determine display configurations for displaying the information from the computer systems 20. The control engine 120 determines metrics such as operation costs, power consumption which may result in lower operational costs, impact on lifetime of the display 14, user acceptance, etc., using the models for each display configuration. Using an algorithm, which may weight the different metrics, such as cost metrics, power consumption metrics, lifetime metrics, and usage metrics, the control engine 120 selects

one of the display configurations for displaying the information from the computer systems 20.

Figures 3A-B illustrate examples of different display configurations. In the examples shown in figures 3A-B, the display 14 is a multi-user display operable to display 5 information from a plurality of sources simultaneously. In figure 3A, the control engine 120 provides a display configuration 310 on the display 14 including windows 301-303. The window 301 includes information from the computer system 20d shown in figure 1, which may include an advertisement server connected to the DREC 10 via the Internet. The window 302 includes flight information from the computer system 20b, which may 10 include a server connected to the DREC 10 via a LAN. The window 303 includes information from the computer system 20a shown in figure 1, such as a word processing document that a user desires to view and edit. The window 303 as shown in figure 3A overlays the windows 301 and 302. Figure 3B illustrates another example of a display configuration provided by the control engine 120. The display configuration 320 shown 15 in figure 3B also includes the windows 301-303. However, the size of the windows 301-303 is changed and the location of the window 303 is changed.

The control engine 120 may select the configuration 310 shown in figure 3A, because the user acceptance (i.e., a usage metric) of using the window 303 in the display configuration 310 is higher (e.g., larger window in the center of the display 14) than the 20 user acceptance of the window 303 in the configuration 320 shown in figure 3B. Also, the windows 302 and 303 may be dimmed in the configuration 310, which may result in reduced power consumption and a lower impact on display lifetime. In addition, the

source display settings 118 for the computer system 20a may require that the window 303 be displayed substantially in the center of the display 14. Alternatively, the control engine 120 may select the display configuration 320 shown in figure 3B, because the cost of using the display 14 to the user of the computer system 20a is lower than the cost if the 5 display configuration 310 were implemented. The cost of using the display 14 for the display configuration 320 may be lower, because the window 303 shown in figure 3B is not as large and is located at the bottom of the display 14. Also, the display configuration 320 may be selected, because the source display settings 118 for the computer system 20a require that the lowest cost window be provided.

10 Figures 4A-B also illustrate examples of different display configurations. In the examples shown in figures 4A-B, the display 14 is a single user display operable to display information from one source at a time. Figures 4A-B illustrate examples of display configurations 410 and 420 including flight information from the computer system 20b, which may include a server connected to the DREC 10 via a LAN. The 15 configuration 420 shown in figure 4B includes a dimmed display. Also, the text may be displayed using green sub-pixels. The configuration 410 shown in figure 4A may not be dimmed and the text may be displayed using red sub-pixels. The control engine 120 may select the display configuration 410 during peak travel times and may select the configuration 420 during non-peak travel times because the display configuration 420 20 results in lower power consumption and lower impact on display lifetime.

Figure 5 illustrates a flow chart of a method 500 for selecting a display configuration. Figure 5 is described with respect to the DREC 10 shown in figures 1 and

2 by way of example and not limitation. At step 501, the DREC 10 receives information to be displayed on the display 14 from one or more sources, such as one or more of the computer systems 20.

At step 502, the control engine 120 shown in figure 2 determines the display 5 source settings for the information received from the sources. The sources may optionally send the display source settings 118. Examples of the display source settings 118 may include displaying an image on the display 14 in one or more specified colors, size of the image, location of the image, etc.

At step 503, the control engine 120 determines a plurality of display configurations 10 for displaying the information received from the sources. The control engine 120 may consider the source display settings 118 when determining the plurality of display configurations. The control engine 120 attempts to satisfy the source display settings 118 for each display configurations. For example, if one of the source display settings 118 includes a position on the display 14 for displaying the information from a source, then the 15 control engine 120 attempts to include the information in the specified position for each display configuration. However, if another source display setting for the same source includes providing a lowest cost for using the display, then the control engine 120 may change the position of the information if it results in a lower display use cost for the source. Also, the control engine 120 may consider metrics, such as cost metrics, power 20 consumption metrics, lifetime metrics, and usage metrics when determining the display configurations. For example, the control engine 120 may determine display configurations, such as the display configurations 310 and 320 shown in figures 3A-B or

the display configurations 410 and 420 shown in figures 4A-B, because these display configurations have varying metrics.

At step 504, the metrics for each of the display configurations are evaluated, and at step 505 one of the display configurations is selected based on the evaluation of the 5 metrics. In one example, the control engine 120 uses a weighting algorithm that weights the different metrics for each display configuration. The control engine 120 then ranks each display configuration and selects one of the highest ranked display configurations. Other algorithms may be used to evaluate the display configurations. For example, the display configurations may be ranked primarily based on cost metrics. The display 10 configuration that generates the most revenue may be selected or the display revenue that results in the least operation costs may be selected. In another example, if the remaining life of the display 14 is below a threshold, then the display configuration that has the least impact on the lifetime of the display 14 may be selected by the control engine 120.

At step 506, the display computer system 12 implements the selected display 15 configuration. Thus, the information from the sources is displayed on the display 14 using the selected display configuration. The method 500 may be used for a multi-user display configuration, such as shown in figures 3A-B, or a single user display configuration, such as shown in figures 4A-B. Also, it will be apparent to one of ordinary skill that various modifications may be made to the method 500 without departing from the spirit and scope 20 of the embodiments. For example, each display configuration may be evaluated as it is determined, such that steps 503-504 are performed substantially simultaneously as each display configuration is determined.

Figure 6 illustrates a block diagram of a computer system 600, which may include the DREC 10 having the display 14 shown in figure 1. The computer system 600 includes one or more processors, such as processor 602, providing an execution platform for executing software that may embody one or more components of the DREC 10.

5 Commands and data from the processor 602 are communicated over a communication bus 605. The computer system 600 also includes a main memory 606, such as a random access memory (RAM), where software may be executed during runtime, and a secondary memory 608. The secondary memory 608 includes, for example, a hard disk drive 610 and/or a removable storage drive 612, representing a SIM 10 or memory card, a floppy diskette drive, a magnetic tape drive, a compact disk drive, etc., or a nonvolatile memory where a copy of the software may be stored. The secondary memory 608 may also include ROM (read only memory), EPROM (erasable, programmable ROM), and/or an EEPROM (electrically erasable, programmable ROM). The removable storage drive 612 reads from and/or writes to a removable storage unit 615 15 in a well-known manner.

 A user interfaces with the DREC 10 with one or more I/O devices 636, such as a keyboard, a mouse, a stylus, speech or hand-writing recognition interfaces, etc. The I/O devices 636 are optional or may be made available only to system administrators for maintenance. The display 14 may include a display subsystem including any combination 20 of the hardware and software modules associated with the visual representation of data for the computer systems 20. For example, the display 14 may include a display controller 622, a display panel 620, display drivers 624 corresponding to the display panel

technology and an image processing module 626. The image processing module 626 may provide geometry and raster processing. The display 14 may be controlled, in part, by controlling its parameters using the display controller 622. Depending on its features, the display parameters 414 can include intensity, color, refresh rate, gray-scale, ambient 5 illumination, contrast, array size, number of tiles and the like, or any combination thereof, and may be related to the display configurations. Software including one or more of the steps of the method 500 shown in figure 5 may provide the necessary instructions to allow the processor 602 to control the display parameters. For example, the processor 602 may instruct the display controller 622 to control the display parameters. Also, the software 10 may be implemented at any layer of a system, including an operating system, windowing environment (if applicable), applications or firmware (not specifically shown), and may communicate with an application to control movement of an image if needed to implement a display control option.

A network interface 630 is provided for communicating with the computer systems 15 20 via the network 40 shown in figure 1. Also, a data interface 640, such as a USB port, serial port, infra-red or radio frequency interface, etc., is provided for receiving information from any of the computer systems 20 without the use of the network 40. Sensors 632 are provided for measuring usage data, power consumption data and lifetime data for the display 14. The sensors 632 may be embodied in software, hardware or a 20 combination thereof.

One or more of the steps of the method 500 may be implemented as software embedded on a computer readable medium, such as the memory 606 and/or 608, and

executed by the DREC 10. The steps may be embodied by a computer program, which may exist in a variety of forms both active and inactive. For example, they may exist as software program(s) comprised of program instructions in source code, object code, executable code or other formats for performing some of the steps. Any of the above may 5 be embodied on a computer readable medium, which include storage devices and signals, in compressed or uncompressed form.

Examples of suitable computer readable storage devices include conventional computer system RAM (random access memory), ROM (read only memory), EPROM (erasable, programmable ROM), EEPROM (electrically erasable, programmable ROM), 10 and magnetic or optical disks or tapes. Examples of computer readable signals, whether modulated using a carrier or not, are signals that a computer system hosting or running the computer program may be configured to access, including signals downloaded through the Internet or other networks. Concrete examples of the foregoing include distribution of the programs on a CD ROM or via Internet download. In a sense, the Internet itself, as an 15 abstract entity, is a computer readable medium. The same is true of computer networks in general. It is therefore to be understood that those functions enumerated below may be performed by any electronic device capable of executing the above-described functions.

While the invention has been described with reference to the exemplary embodiments thereof, those skilled in the art will be able to make various modifications to 20 the described embodiments without departing from the true spirit and scope. The terms and descriptions used herein are set forth by way of illustration only and are not meant as limitations. In particular, although the method has been described by examples, the steps of the method may be performed in a different order than illustrated or simultaneously.

Those skilled in the art will recognize that these and other variations are possible within the spirit and scope as defined in the following claims and their equivalents.